EXAMPLE INTERCONNECTION OF ARCHITECTURES, CABLE AND TELECOMMUNICATIONS SYSTEMS

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INTRODUCTION

Industry reports indicate that Cable and Telecommunications System capabilities are planned to be joined or are being joined. Various companies and consortiums have announced that they plan to offer telecommunications type capabilities over modified cable distribution plant or cable type capabilities over enhanced telecommunications plant. One of the early capabilities which many companies plan to offer over modified cable or telecommunications plant is a wireless communications service referred to as Personal Communications Service (PCS). This paper will concentrate on three typical architectures which could be used to provide PCS. The paper will discuss the interconnection of these typical PCS networks with Local Exchange Carrier (LEC) network. Personal Communications Service (PCS) is a term which has different meanings to different telecommunications service providers. Hence, several views of PCS have arisen as the industry begins to launch initial service offerings. This paper will overview these typical interconnections between three commonly discussed PCS architectures and a LEC. These three PCS architectures are:

1. Personal Communications Network (Diagram 1) - This architecture is being used by some cellular system operators and is being considered by start - up PCS companies who are planning new telecommunications infrastructure for PCS.

2. Cable Systems (Diagram 2) - This architecture is typical of the planned deployment of PCS in some cable systems.

3. Bellcore Proposed Arrangement (Diagram 3) - This architecture has been proposed by Bellcore as a modularized approach to network elements which could be interconnected with a typical Regional Bell Operating Company.

In order to appreciate the commonality of interconnection between PCS and a typical LEC, a review of the commonality of the industry (as a whole) and consumer perspective of PCS is in order.

The FCC (in Docket 90-314, para. 24) defined PCS as a service that will "encompass a wide array of mobile, portable and ancillary communication services and ancillary communication services to individuals and businesses and (will) be integrated with a variety of competing networks.

Early consumer survey responses[1] describe PCS services having some of these attributes:

PERSONAL

Peace of Mind - Being able to reach friends and family members at a moment's notice, around the clock.

Flexibility - Having the capability to communicate across home, mobile, and office environments using just one phone number.

Accessibility - Controlling how much access users want and need.

BUSINESS

Increased Productivity - Turning down - time into useful time, around the clock.

Customer Service - Handling consumer requests instantly.

Flexibility - Never being out of touch.

The overall attributes which a wireless service provider(s) should have the capacity to provide to meet these customer needs include:

Personal number, so that a user can be reached independent of physical location.

Seamless operation, so that a user can enjoy uninterrupted service as they move from one service providers area to another.

Service profile portability, so that a user can move between service providers and retain the same features, such as calling class of service, dialing patterns, screening options and billing arrangements.

Wide area of service, so that a user can move easily on a local or long distance basis.

Screening capability, so that a user can control incoming calls and therefore, their accessibility.

These capabilities are provided to a greater or lesser degree by each of the architectures described. Due to regulatory and legal limitations and business arrangements, the typical PCS network, regardless of architecture, initially will not provide all of the attributes described. Therefore, interconnection with other networks will be necessary to provide services which customers are asking for, based on market information. Moreover, since the existing landline (LEC) network has a large number of subscribers (approximately 145 million access lines), the ability to connect to this large body of users is important to other networks.

Interconnection compatibility information for a LEC to Wireless Services Provider interconnection is described in TR-NPL-0001452. The type of interconnection that is used depends on WSP needs and availability from the LEC, as it is a matter of negotiation between the WSP and LEC. Interfaces which provide the basic interconnection to these three architectures is described in this document. An overview of these example interconnection types is the subject of the remainder of this paper with comments as to how these interconnection types would apply to the three architecture types.

INTERCONNECTION TYPES AND INTERFACE WITH PCS ARCHITECTURES

Type 1

The Type 1 interface is at the Point of Interface (POI) of a trunk between a Wireless Services Provider (WSP, which includes PCS services providers) and a LEC End Office (EO) switching system. The WSP establishes connections to the directory numbers served by this LEC EO an other carriers through this interconnection arrangement (Diagram 4).

Incoming calls are handled through the Type 1 interconnection using Multifrequency (MF) trunk signaling protocols. With this Type 1 interconnection, the WSP can establish connections through the LEC network to valid office codes (NXXs) within the LEC local network, LEC Directory Assistance, LEC operator assistance or services provided by Interexchange Carriers (ICs), International Carriers (INCs) and other wireless services providers or local exchange carriers. Outgoing calls from the LEC switched network to the WSP are handled through the Type 1 interconnection using MF trunk signaling to identify the called wireless customer station number without manual or operator assistance.

Type 1 can be applied to the interface for the PCN architecture (Diagram 1) as described above. The Cable architecture can use a Type 1 interconnection from a suitably equipped base station (Diagram 2). Type 1 can be applied, in addition at the Network Interface to the switch (Diagram 3).

The Type 1 Variation interface is based on a National ISDN arrangement. This interface is based on either a Primary Rate Interface (PRI) or Basic Rate Interface (BRI). Other references which will assist the reader in understanding the ISDN interface include SR-NWT-0019373 , SR-NWT-0021204 , TR-NWT-001268 5 , TR-TSY-000268 6 .

Type 1 Variation can be applied to the interface for the Bellcore PCS architecture (Diagram 3) between the Radio Port Control Unit (RPCU) and the Switch. ISDN provides the out of band signaling capability which provides the capacity for the protocol transfer to assist in the network arrangements required for the switch - controller - port interconnection.

Type 2

The Type 2A interface is at the POI of a trunk between a WSP and a LEC tandem switching system. Through this interconnection arrangement, the WSP can establish connections to the LEC EO and to other carriers accessible through the tandem (Diagram 4).

Incoming calls are handled through the Type 2A interconnection using inband MF trunk signaling and trunk address signaling protocols. With the Type 2A interconnection, the WSP can establish connections via the LEC network to valid local network area office codes (NXXs) accessible through the tandem or services provided by ICs, INCs and other WSPs or LECs associated with the local network area.

Outgoing calls from the LEC to the WSP are handled through the Type 2A interconnection using trunk address signaling protocols and MF signaling for identification of the called wireless user's station. Calls are normally routed to the POI based on the NPA and NXX. Shared NXX arrangements with Type 2A are not common and require special translations for routing.

The Type 2A interface can be used, for example:

- As shown in Diagram 1 (or with SS7 in an out of band signaling variation with a Type S - see below)

- With a suitably equipped Base Station in Diagram 2

- At the Network Interface in Diagram 3

The Type 2B interface is at the POI of a trunk between a WSP and LEC EO switching system. The Type 2B interconnection may only provide connections between the WSP and Directory Numbers served by the one EO to which it is interconnected. A Type 2B interconnection may be used in conjunction with the Type 2A interconnection on a high-usage alternate routing basis to serve high-volume traffic between the WSP and the LEC EO (Diagram 4).

Incoming calls are handled through the Type 2B interconnection using trunk address signaling protocols and MF signaling to identify the called station number. With this interconnection, the WSP can establish connections with customers or carriers (e.g. Feature Group A - FGA - IC or a WSP using a Type 1 interconnection) served by DNs in the LEC EO to which it is interconnected. In contrast to the Type 1 interconnection, Type 2B should not be used to route WSP calls to FGB, FGC or FGD ICs or to ICNs.

Outgoing calls from the LEC EO to the WSP are handled through the Type 2B interconnection using trunk address signaling protocols and MF signaling for identification of the called WSP station. Calls routed to the POI based on the NPA and NXX, or 1000s block, if required.

The Type 2B interface can be used at the interconnection point shown in Diagram 1 and at the same PCS architecture points noted for the Type 1 interface for Diagram 2 and 3.

Type S

The Type S (Signaling) interface is a physical SS7 signaling link connection between a LEC network and a WSP network. The 's' in Type S indicates that signaling information is passed via this interface. The Type S interface is used between a LEC and a WSP to exchange SS7 ISDNUP and SS7 TCAP messages to support the applications to be provided between the WSP and LEC networks. The physical interface specifications for the Type S interface are based on Section 6 of TR-TSV-0009057. The Type S interface may also be use to pass information to other networks. The Type S interface is a physical interconnection. Functions or applications provided by a LEC for a WSP or by a WSP for a LEC would ride over this interface. Specific application implementation will vary among LECs.

Examples of applications which could use the Type S interface include call set up (over a Type 2A or 2B interface, mentioned above). The Type S interface would require a Type 2A or 2B as well to function. See TR-NPL-000145. See Diagram 4. PCS architectures which could use this type of application include Diagram 1, as shown and Diagram 2, where a "Base Station" element in the architecture would have to be equipped for common channel signaling. This application could also be used at the Network Interface in Diagram 3.

Another possible application of the Type S interface is a signaling only interface, such as to transport roaming protocol for authentication and validation functions within the combined networks. A protocol which could be used for this type of function is IS-418. This example is shown in Diagram 1 and 4. A modified IS-41 protocol is used for this type of function in the Bellcore architecture and the Type S could be employed at the Database Interfaces in Diagram 3. Also see References[9,10,11,12,13]

Summary

Example interconnections have been presented here for typical architectures planned to deliver PCS capabilities. PCS architectures were examined, since these services have a high profile, currently in the industry and are services which many cable operators have discussed as initial or early telecommunications capabilities over their networks.

In conclusion, the three typical PCS architecture arrangements being discussed in the industry today have a number of commonalties for call transport and signal processing.

These commonalties are beneficial for the industry, in that a number of network and architecture combinations can be interconnected, as discussed. This will support an expanded level of services to the customers of all of these carriers.

REFERENCES

1. Bell Atlantic Mobile / Carnegie Mellon University study and Bell Atlantic Personal Line, one number trial in Pittsburgh, as reported in "Advanced Intelligent Network News", November 24, 1993.

2. TR-NPL-000145 I2 Compatibility Information for Interconnection of a Wireless Services Provider and a Local Exchange Carrier Network, Bell Communications Research, December, 1993.

3. SR-NWT-001937, National ISDN - 1, Bell Communications Research, February, 1991.

4. SR-NWT-002120, National ISDN - 2, Bell Communications Research, June, 1993.

5. TR-NWT-001268, ISDN Primary Rate Interface Call Control, Bell Communications Research, December, 1992.

6. TR-TSY-000268, ISDN Access Call Control Switching, Bell Communications Research, May, 1989.

7. TR-TSV-000905, Common Channel Signaling Network Interface Specification, Bell Communications Research, October, 1993.

8. Cellular Radiotelecommunications Intersystem Operations Standard 41

9. T1.111-1992, Signaling System Number 7, Message Transfer Part.

10. T1.112-1992, Signaling System Number 7, Signaling Connection Control Part.

11. T1.113-1992, Signaling System Number 7 Integrated Services Digital Network User Part.

12. T1.114-1992, Signaling System Number 7 Transaction Capabilities Application Part

13. TA-TSV-001411, PCS Access Services Interface Specifications, Bell Communications Research, August, 1993

Personal Communications Network (PCN) Concept

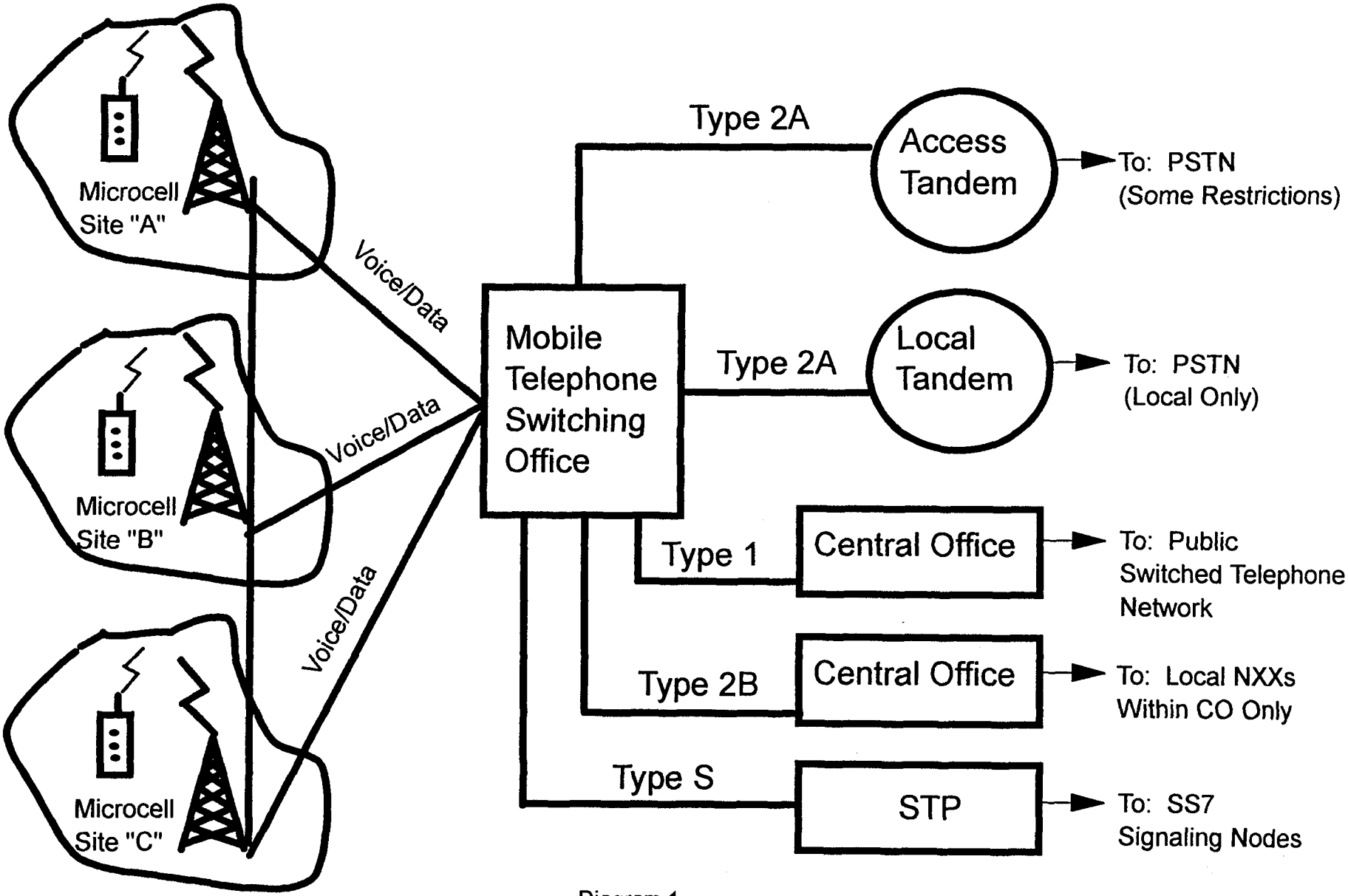
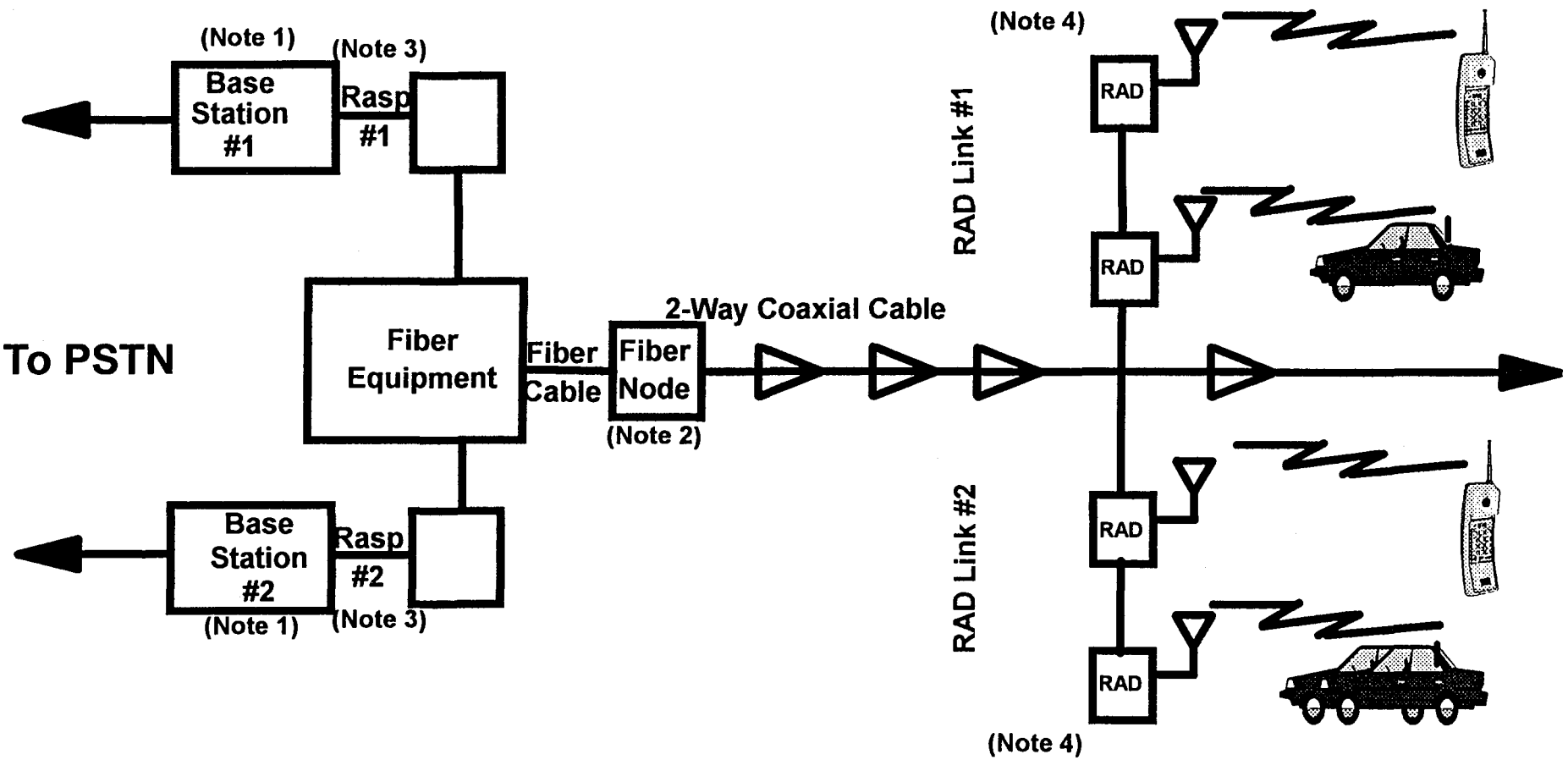


Diagram 1

Generic Cable Architecture for PCS



Notes:

(1) Multiple Base Station: Provides channel allocation, power control, handoff for radio channels and interface to PSTN.

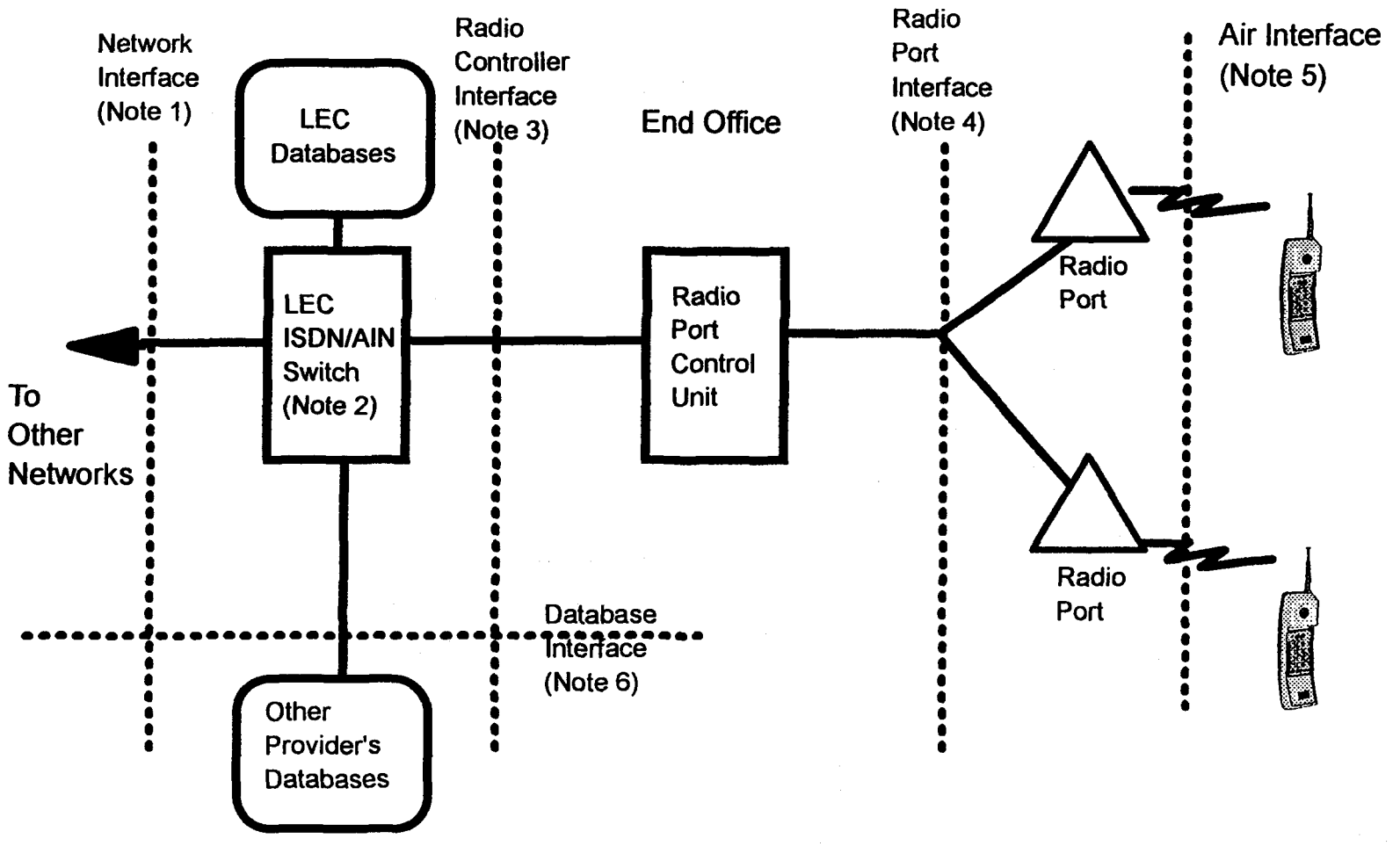
(2) Fiber Node: Contains equipment to convert optical signals to electrical.

(3) Remote Antenna Signal Processor (RASP): Controls Remote Antenna Drivers (RADs) via signals from Base Station.

(4) Remote Antenna Drivers (RADs): Remote antennas providing coverage within radius of approximately 500-1,500 feet. Each series of RADs emanating from the RASP simultaneously transmit identical frequencies. Handoff between RAD Link #1 and RAD Link #2 is possible. Handoffs are controlled by Base Station via signals to RASP.

Diagram 2

Simplified Bellcore Proposed PCS Architecture



NOTES:

(1) Includes any switched interconnection to PSTN, e.g. Type 1, Type 2, DID and SS7
(2) May be several switches. Must have ISDN capabilities. AIN and SS7 features need further development.
(3) Standard not yet formalized. Initial Bellcore proposal uses ISDN-BRI connection.
(4) Standard not yet formalized. Link may be leased analog, digital, or fiber. Initial Bellcore proposal is TI, DSL, or DLC links.
(5) Standard not yet formalized. Bellcore proposes using TDM/TDMA per TA-NWT-001313.
(6) Database owned by another provider. Signaling link is 56kbps data line.

Diagram 3

Interconnection Examples Overview

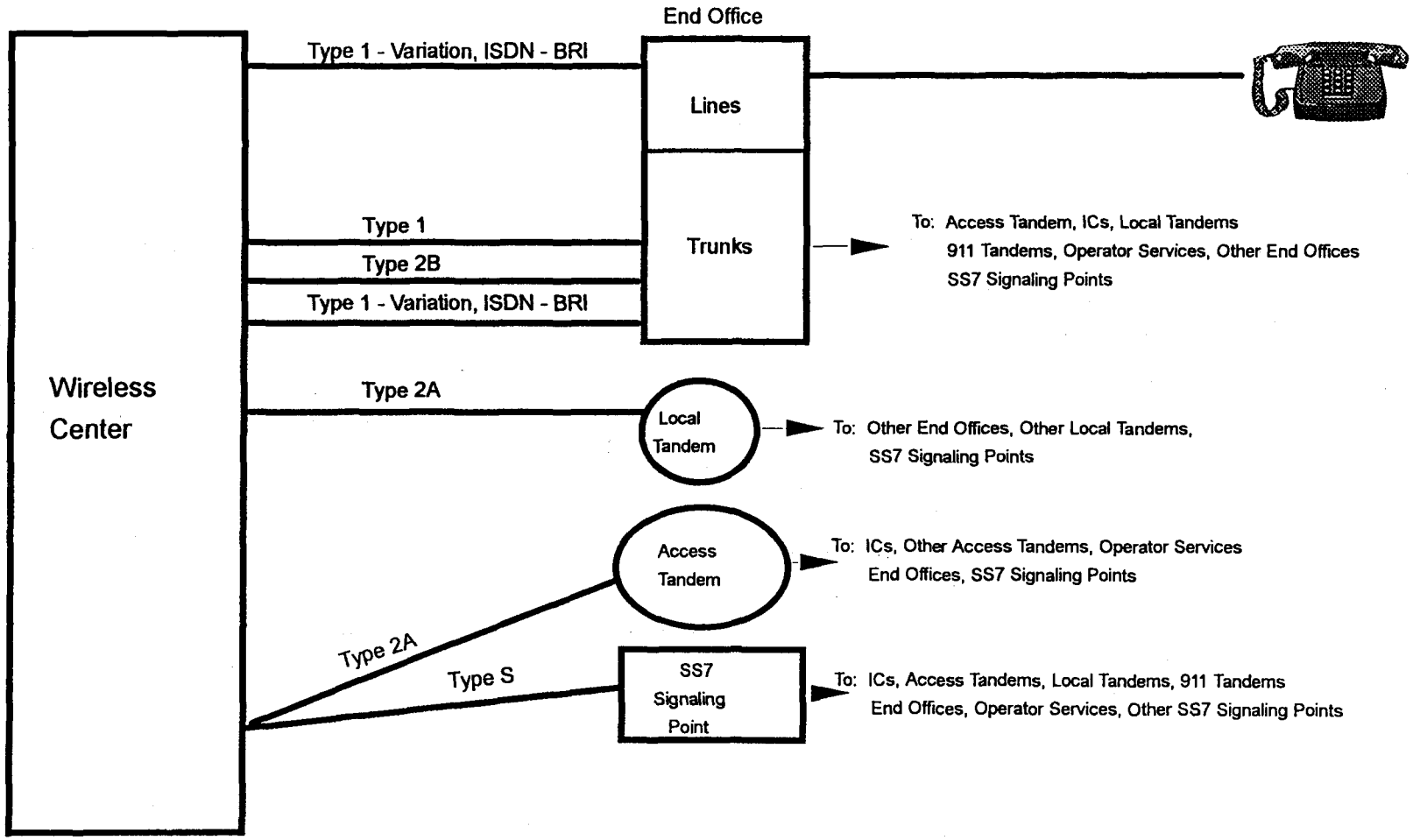


Diagram 4